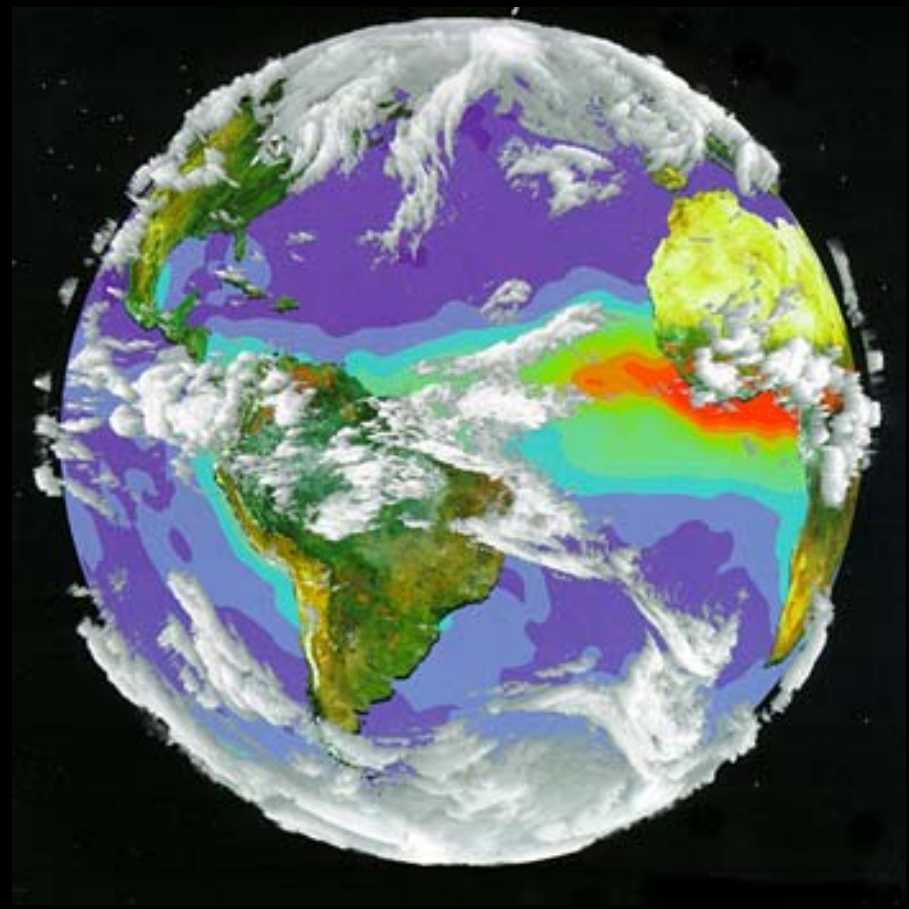
Earth Science Enterprise

Science for Society: Delivering Earth System Science Knowledge for Decision Support in the Year 2025

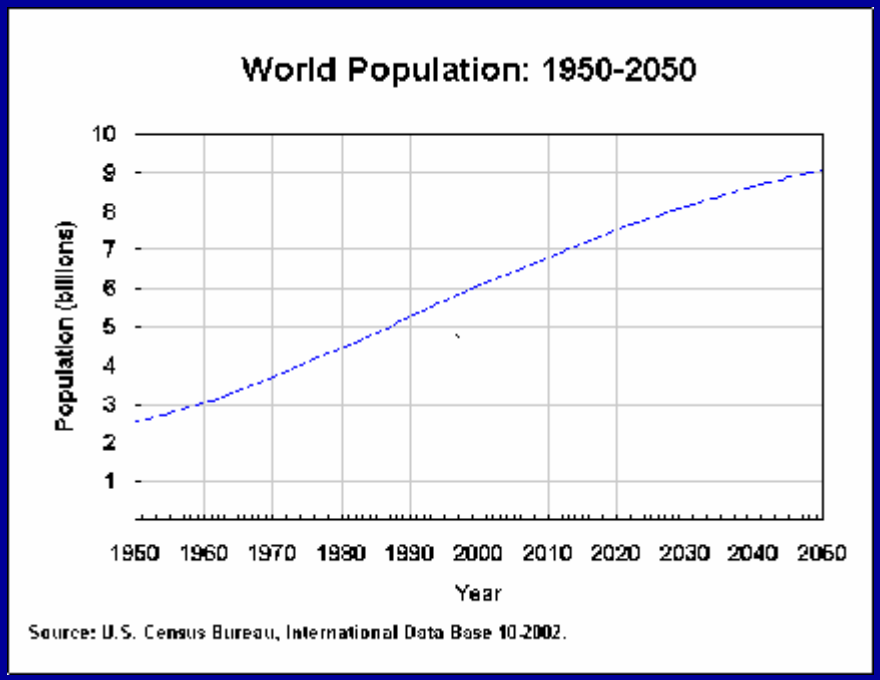


Roger L. King & Ronald J. Birk
NASA
Washington, DC

"Accelerating the realization of economic and societal benefits from Earth science, information, and technology …"

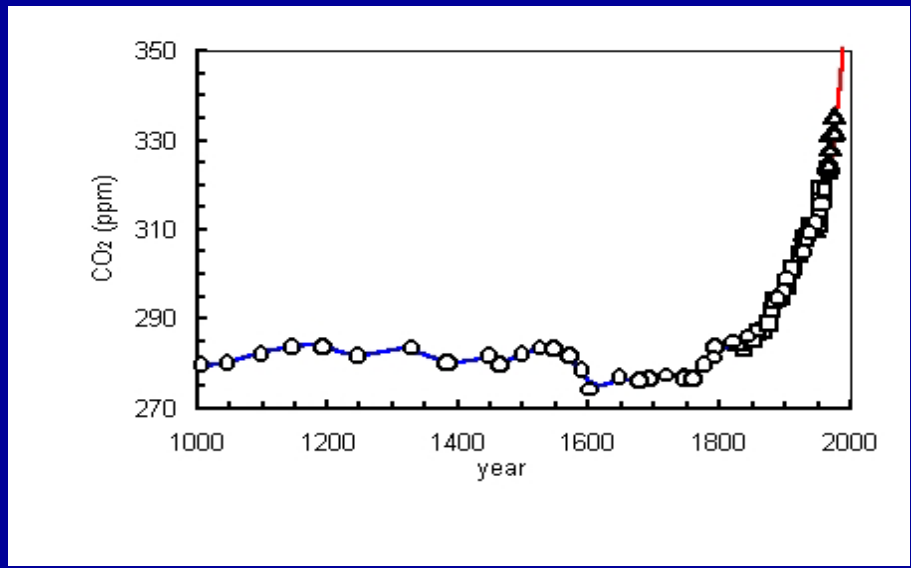

The NASA Vision
To improve life here,
To extend life to there,
To find life beyond.
The NASA Mission
To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
... as only NASA can.

Earth's Population Continues to Grow

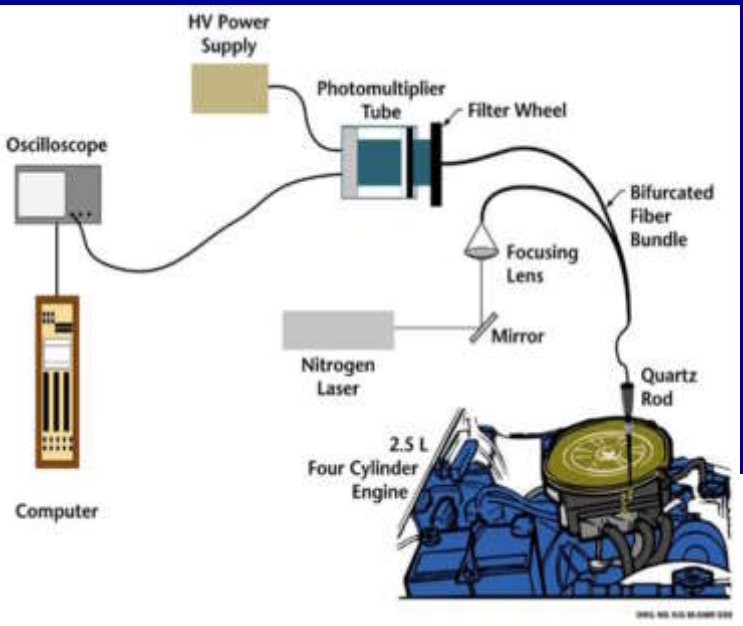


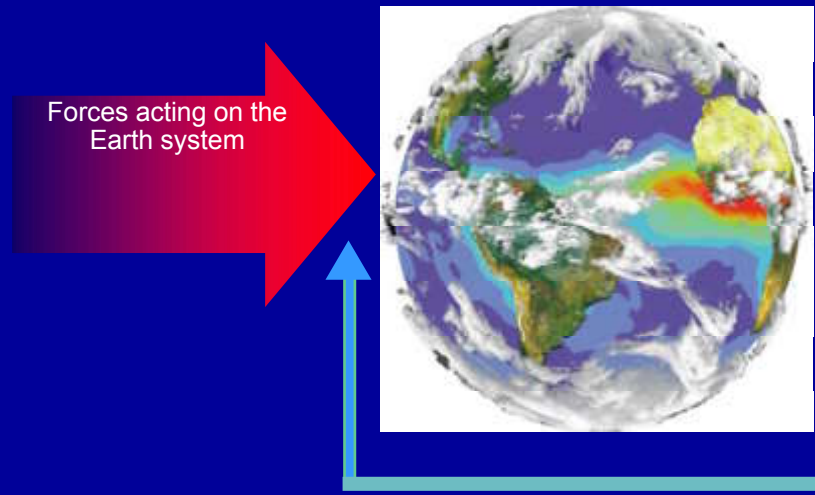
- 6 billion – 1999
- 8 billion - 2025

- However, there are consequences.



Important Systems For Life





Feedbacks

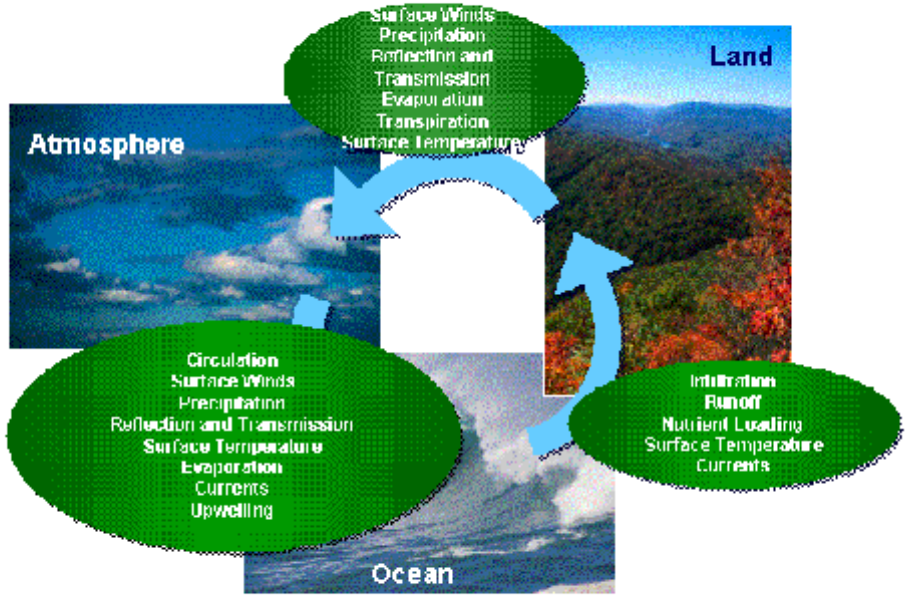
Planet Earth is a Dynamic System

Fresh Water – Finite Resource

- View of Earth from space as a “Blue Marble” gives mankind a false sense of security. Only a small fraction of the planet’s water wealth can be tapped and that share must sustain life for mankind plus numerous other species.
- Nearly 1 out of every 3 people in the developing world - some 1.2 billion people in all – do not have access to a safe and reliable supply for their daily needs.

Freshwater and the Food Supply

- Evaporation - 500,000 cubic kilometers
- An equal amount falls back to earth as rain, sleet, or snow, but in a different distribution.
- However, all of this precipitation cannot be captured.
- The net captured for use by mankind is ~14,000 cubic kilometers. This serves as the planet's stable freshwater supply.
- Water available per person - 2,222 cubic meters – 2003; 1750 cubic meters - 2025. (low meat diet for one person for a year - 1100 cubic meters)



All of Earth's Natural Resources are Finite

- The same can be said of Earth's other resources (finite and not evenly distributed)
  - Energy
  - Land resources
    - Pasture
    - Cropland
    - Forest products
  - Atmosphere
  - …
- However, the world's expanding population requires the use of these resources for a basic quality of life. Therefore, there must be a vision to ensure sound (fiscal & environmental) management of these resources.

Assumptions for a Global Information Infrastructure

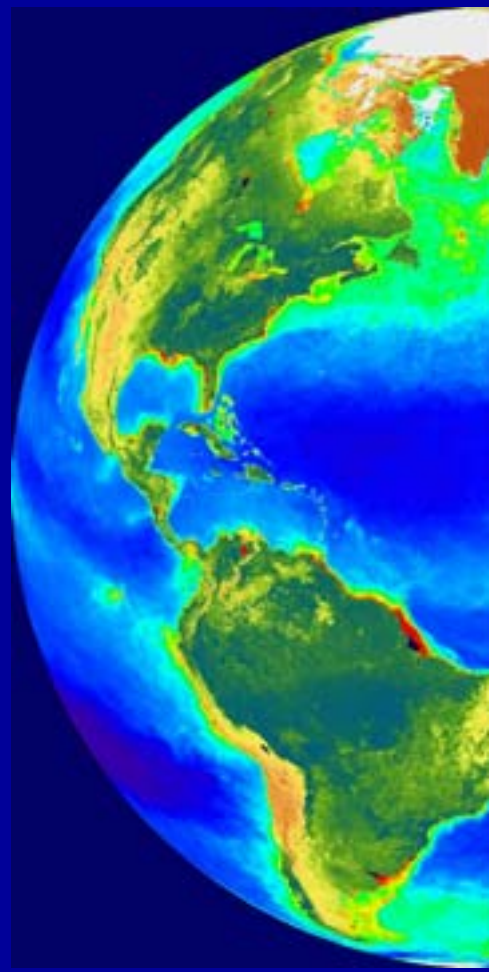
- The Earth's resources (e.g., food, water, energy, and land) available to serve the growing population are limited.
- The Earth system is affected by anthropogenic influences.
- Our understanding of the Earth system as a dynamic set of interactive processes (involving oceans, land, and atmosphere) is increasing.
- As the world's population continues to increase the Earth's finite resources will be shared by an increasing number of people. The equitability of this division will be a driving force in world political stability.
- The countries of the world are challenged to balance economic and Earth resources security and stewardship.
- There are basic needs of the world's population that are not effectively being served today (e.g. water quality and quantity).

How is NASA Helping to Meet This Challenge?

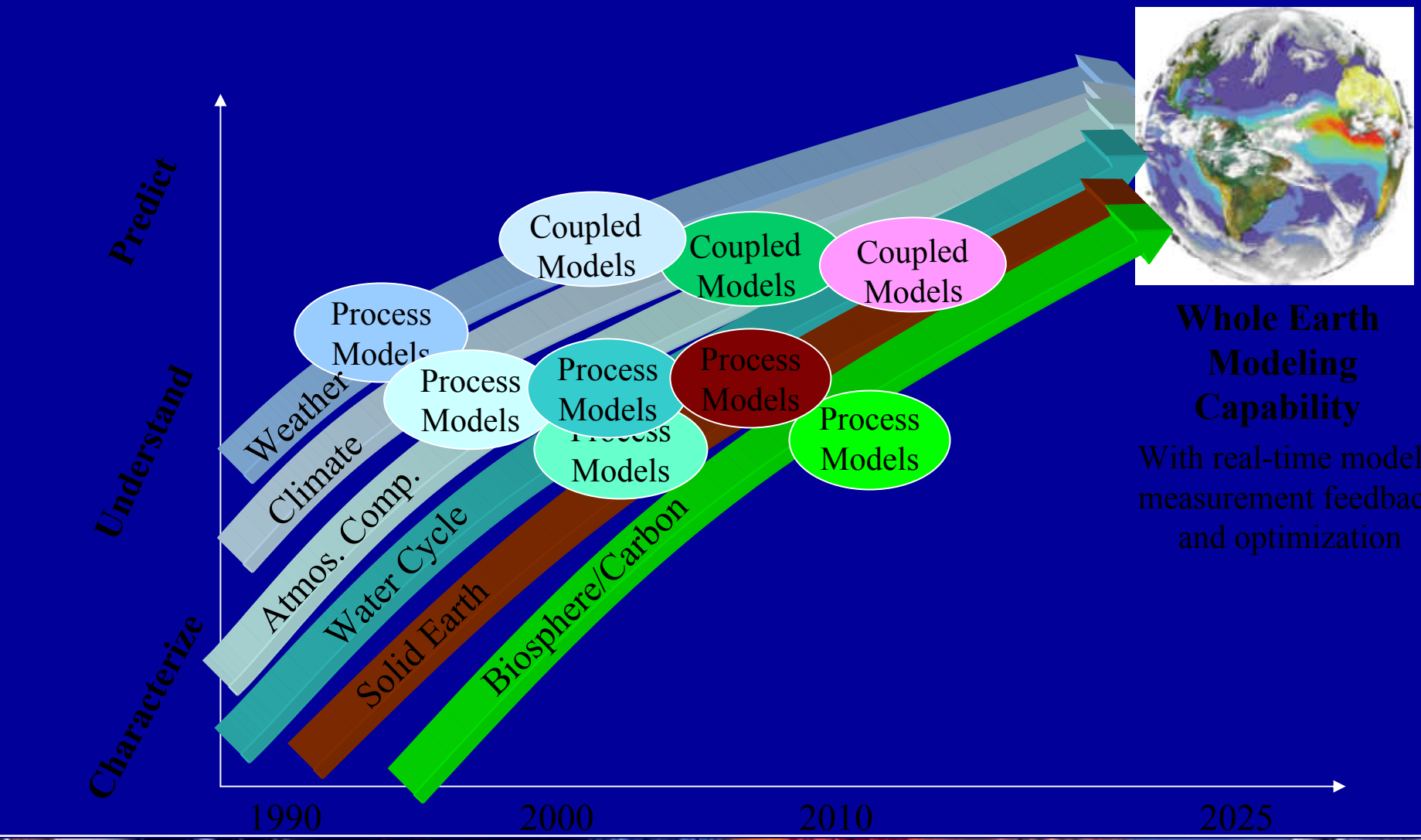
- Describing the interactions among Earth's continents, oceans, atmosphere, ice, and life
- Making global observations at 'scales that matter', i.e., at regionally discerning resolutions
- Accurately representing these interactions & ingesting these observations into coupled Earth system models
- Creating processes of prediction and assessment in forms useful to decision-makers

Serving Societal Needs Requires Scientific Understanding

- How is the Earth Changing and What Are the Consequences for Life on Earth?
- How is the global Earth system changing?
- What are the primary causes of change in the Earth system?
- How does the Earth system respond to natural and human-induced changes?
- What are the consequences of changes in the Earth system for human civilization?
- How well can we predict future changes to the Earth system?



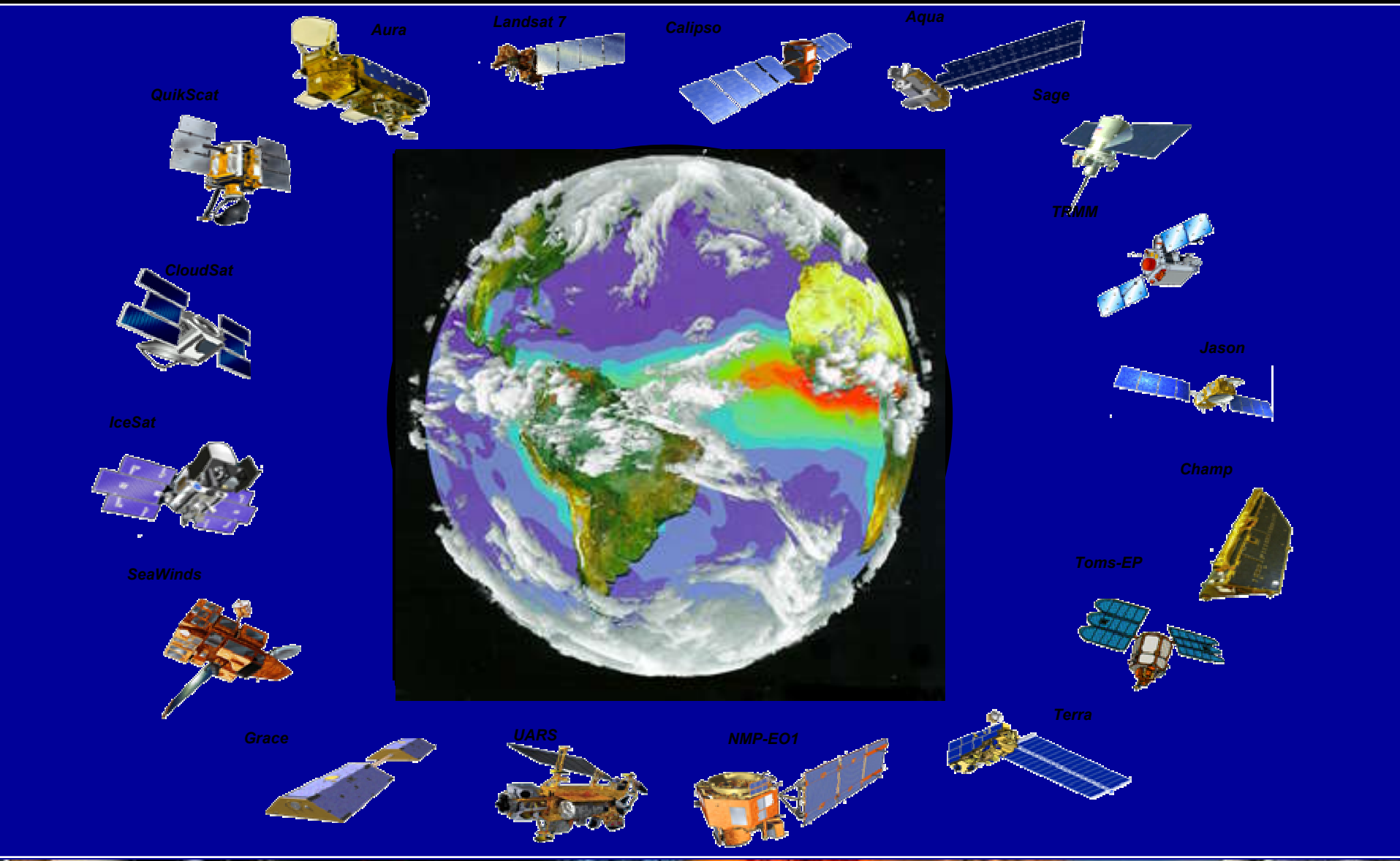
Earth System Science



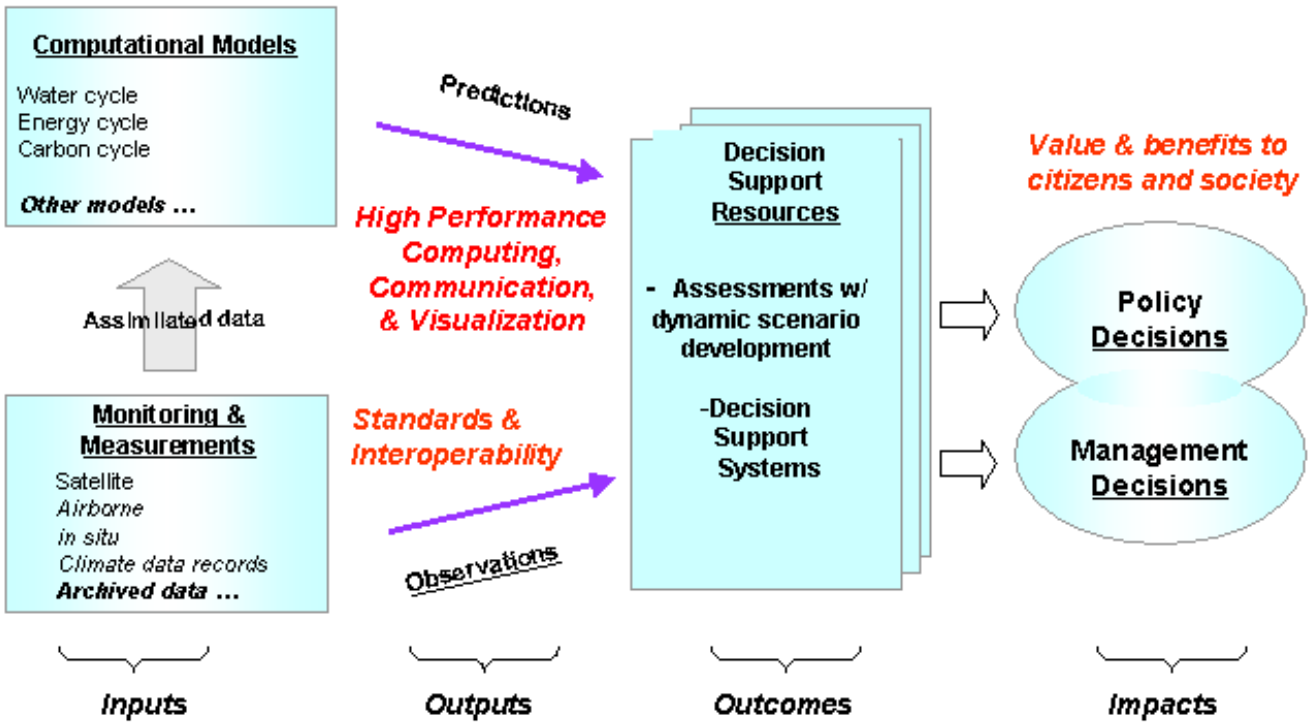
Whole Earth Modeling Capability

With real-time model - measurement feedback and optimization

An Armada Providing Global Measurements



A Solution: An Architecture



An Earth Resources Management Decision Support System

Issues in the Proposed Infrastructure

- Computational models that fully describe the Earth system processes (oceans, atmosphere, land, life) with a fidelity and interoperability for supporting the decision making process.
- The need for an integrated and sustained Earth observation system (including *in situ*, sub-orbital, and satellites).
- Recognition of the need of the global community to support the components that comprise a long-term solution to managing the Earth's limited resources.
- Support to the Earth resources information economy (e.g., carbon trading, water resources, energy management, etc.).
- Recognition of the economic considerations that are intrinsic to the developed and developing nations that a management infrastructure will serve.
- International collaboration to integrate the components (observations, models, predictions, etc.) into an infrastructure for the benefit of all nations.

Challenge to the Global Community

- Improving life here on planet Earth is foremost in NASA's vision, and in the larger purpose of NASA's Earth Science Enterprise.
- The vantage point of space yields information about Earth's land, atmosphere, ice, oceans and life that is obtainable in no other way.
- Global-scale changes require global-scale observations and models, and many regional and local changes are only truly understood when seen in this larger context.
- It is also true that the challenge of managing the Earth's natural resources can only be answered within the global context.
- Therefore, as we use the vantage point of space to increase our understanding of our home planet, we can use the same models, technologies, and observations to manage Earth's natural resources.

Enabling Solutions for Society